Mission Directorate: Space Technology

Overview

Space Technology is the central NASA contribution to the President's revitalized research, technology, and innovation agenda for the Nation. These investments will stimulate the economy and build the Nation's global economic competitiveness through the creation of new products and services, new business and industries, and high-quality, sustainable jobs. A technology-driven NASA positions the Nation's aerospace community as a global technological leader and serves as an inspiration for young people to pursue science, technology, engineering, and mathematics (STEM) education and career paths. Space Technology focuses not only on the technological advances required for NASA's future missions in science and exploration, but also on providing space technologies that can improve the capabilities and lower the cost of other government and commercial space activities.

NASA technology development activities under Space Technology transform the Nation's capabilities for exploring and utilizing space. Through Space Technology, NASA advances crosscutting and exploration-specific technology, performs technology transfer and technology commercialization activities, develops technology partnerships with other Government agencies, and coordinates the Agency's overall technology investment portfolio. The Office of the Chief Technologist (OCT) manages Space Technology.

The NASA Authorization Act of 2010 endorses Space Technology, stating, "It is critical to maintain an Agency space technology base that helps align mission directorate investments and supports long term needs to complement mission-directorate funded research and support, where appropriate, multiple users, building upon its Innovative Partnerships Program and other partnering approaches." In addition, the Act supports "development of technologies and in-space capabilities for beyond near-Earth space missions."

Consistent with the NASA Authorization Act of 2010, NASA recently developed a draft set of 14 space technology roadmaps (available at http://www.nasa.gov/offices/oct/home/roadmaps), which define pathways to advance the Nation's capabilities in space and establish a mechanism for prioritization of NASA's technology investments. The National Academies is reviewing these roadmaps to provide independent guidance and recommended prioritization for NASA's future technology investments. NASA uses these space technology roadmaps and the Space Technology Grand Challenges, a set of technically challenging, long-term space-related goals, to guide NASA's technology portfolio and prioritize future technology investments.

In managing Space Technology NASA employs a portfolio approach that spans technology readiness levels from concept study to flight demonstration. These technology development activities include early stage conceptual studies, ground-based and laboratory testing aimed at demonstrating technical feasibility, relevant environment flight demonstrations, and technology test beds, which include the International Space Station (ISS). The activities funded in Space Technology provide a balance between long-range, mission-focused technology investments and transformational technology investments that enable revolutionary capabilities. To achieve its Space Technology goals, NASA sponsors relevant activities at its Centers, in academia and industry, and in partnership with other Government agencies. The acquisition approach includes both competed and strategically guided activities. Integrated technology transfer efforts ensure NASA technologies are infused into commercial applications, promoting the creation of new jobs and maturing new products and services that benefit the Nation and the world.

For more information about Space Technology, please visit http://www.nasa.gov/offices/oct.

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	Auth Act FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**275.2**	**327.2**	**512.0**	**1,024.2**	**1,024.2**	**1,024.2**	**1,024.2**	**1,024.2**
Space Technology	275.2	-	-	1,024.2	1,024.2	1,024.2	1,024.2	1,024.2

Note: FY 2010 and FY 2011 figures have been adjusted to show comparable Exploration technology content from the Exploration account, and the movement of the Innovative Partnerships Program from the Cross Agency Support account, within the Space Technology account consistent with the FY 2012 Budget.

The "Auth. Act FY 2011" column represents FY 2011 authorized funding from the NASA Authorization Act of 2010 (P.L. 111-267). For the Space Technology account the amount shown represents the $350 million authorized for Space Technology and a portion of the $250 million authorized for the Exploration Technology Development activities that have been transferred to this account in the FY 2012 Budget. For FY 2012, the NASA Authorization Act of 2010 included approximately $800 million for Space Technology and the transferred Exploration Technology Development activities.

The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

Plans for FY 2012

Space Technology

Space Technology

New Initiatives:

None

Major Changes:

In the FY 2011 budget request, Space Technology funding was included under the Aeronautics and Space Research and Technology appropriations account. For the FY 2012 request, NASA has established Space Technology as a unique appropriations account.

In FY 2012, a significant portion of the FY 2010 Exploration Technology Development Program, as well as new exploration technology activities in planning for FY 2011, will move from the Exploration Systems Mission Directorate (ESMD) to Space Technology. For traceability, the transferred activities have been consolidated in a specific budgetary element within Space Technology: Exploration Technology Development (ETD). Some elements of exploration technology efforts, such as life support, extravehicular activity, and habitation development, will remain in Exploration Systems due to their engineering development nature and strong coupling to exploration crew vehicle systems. NASA plans to capitalize on technical and management synergies in integrating and managing this technology portfolio.

Major Highlights for FY 2012

Space Technology will focus on developing breakthrough space capabilities and applications. Supporting national efforts in innovation, NASA is developing a robust pipeline of technology developments that enable new approaches to scientific and human exploration of the solar system.

In FY 2012, NASA will receive two reports from the National Academies on NASA's space technology roadmaps containing independent guidance and prioritization for NASA's future technology investments. NASA will use this input to guide Space Technology solicitations that develop and demonstrate advanced space systems concepts and technologies, and enable new, currently unfeasible, approaches to achieving NASA's current missions and future missions. The National Academies' response to the NASA roadmaps supports NASA's contribution to the National Space Technology Policy called for in the NASA Authorization Act of 2010 (P.L. 111-267).

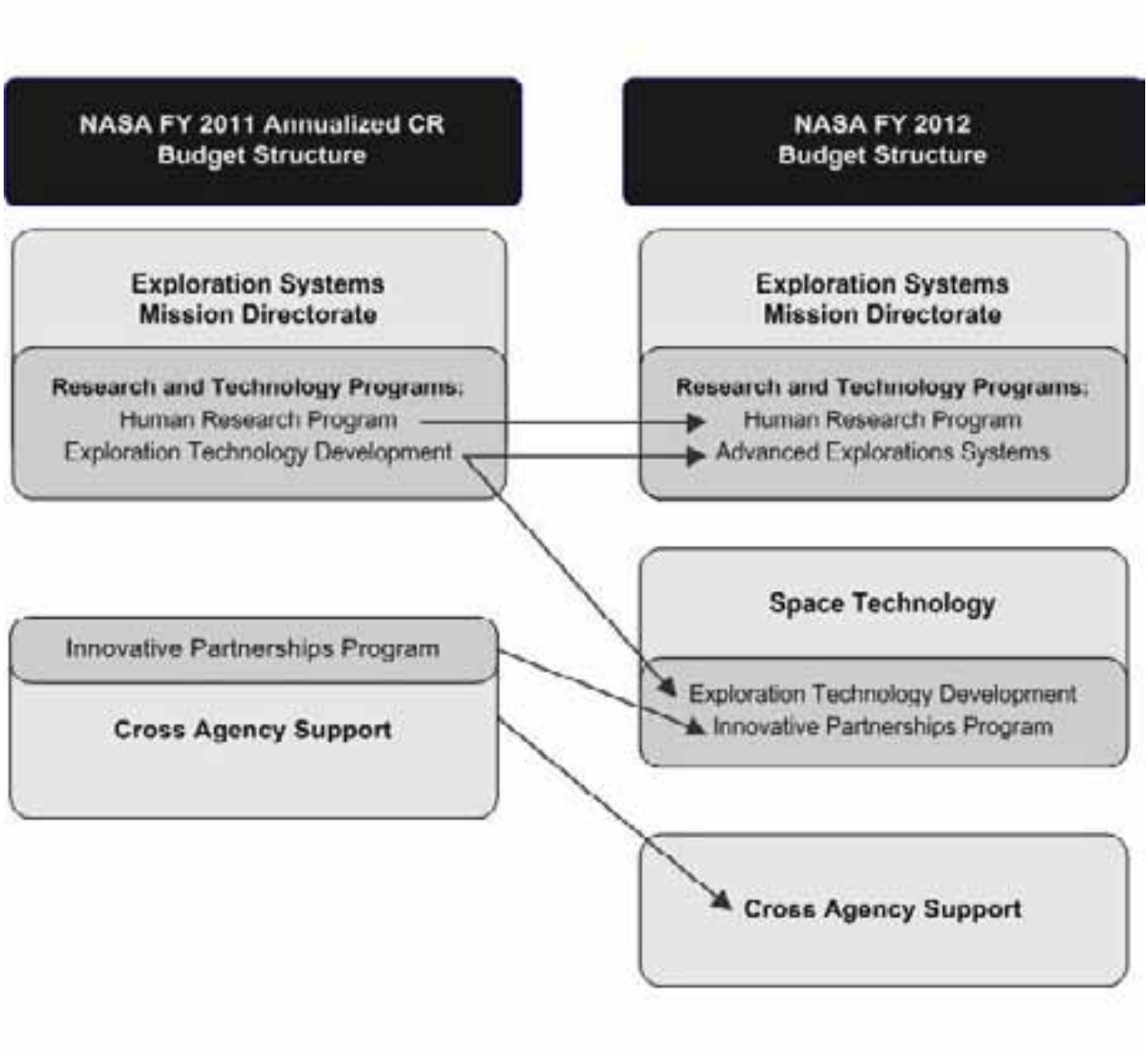
NASA aligns Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) topics and subtopics with NASA's technology roadmaps. Chief Technologists from NASA Centers and the Jet Propulsion Laboratory will coordinate between Center SBIR and STTR projects and mission needs on topic development, selection, project administration, infusion activities, and reporting processes. A Mission Directorate steering council will maximize alignment and infusion of the SBIR and STTR products into future missions and systems. This approach more fully integrates and couples the SBIR and STTR programs as critical components of the Agency's technology development activities, providing the small business researchers with more efficient infusion paths for viable products.

In Crosscutting Space Technology Development (CSTD), NASA funds NASA Innovative Advanced Concepts (NIAC) Phase I and Phase II studies, develops a cadre of space technology graduate fellows, conducts Centennial Challenges competitions, awards new grants for foundational space technology research, invests in innovative research activities at NASA Centers, implements Game Changing Development (GCD) activities that lead to revolutionary technologies, sponsors new Franklin Small Satellite Subsystem Technology projects, procures suborbital flight services from commercial reusable suborbital and parabolic platform providers, and initiates in-space Technology Demonstration Missions and Edison Small Satellite Demonstration Missions. NASA's Mission Directorates, other Government agencies, and industry are the ultimate customers for CSTD products.

Exploration Technology Development (ETD) manages both strategically-guided and competed project elements focused on critical technology advances necessary for humans to explore beyond low Earth orbit. ETD leverages the existing technical strength of the NASA Centers and known needs for the future human exploration activities. Competed ETD projects augment and complement the guided efforts, providing the opportunity to develop the best ideas, innovations, approaches, and processes for the future human space exploration efforts. ESMD is the primary customer for ETD products.

Maintaining two robust space technology development programs allows the Exploration Technology Development and Crosscutting Space Technology Development budgetary elements to focus on different sets of customers and goals, operate with a different balance of competed and guided project elements, and use different cost-share requirements.

Mission Directorate Budget Structure Adjustments



Mission Directorate:	Space Technology
Theme:	Space Technology

Theme Overview

Space Technology consists of four budgetary elements: Partnership Development and Strategic Integration, SBIR/STTR, CSTD, and ETD.

The Partnership Development and Strategic Integration element includes technology transfer and commercialization, interagency technology coordination, intellectual property management, and technology partnership opportunities with other Government agencies and commercial industry. Consistent with the NASA Authorization Act of 2010, this budgetary element also has the responsibility to align NASA's technology investments, ensuring that Space Technology investments, as well as technology investments from other agencies, and future mission plans.

NASA tracks the maturity of technologies funded by Space Technology through use of Technology Readiness Levels (TRLs). Tracking TRLs provides insight into the progress of each technology, and over time, the performance of commercialization and infusion processes. For more about TRLs, please see http://www.hq.nasa.gov/office/codeq/trl/trl.pdf.

SBIR and STTR continue to support early-stage research and development performed by small businesses through competitively awarded contracts. These programs produce innovations for both Government and commercial applications. SBIR and STTR provide the high-technology small business sector with an opportunity to develop technology for NASA, and commercialize that technology to spur economic growth. Technologies funded by SBIR and STTR have contributed to numerous NASA programs and projects and also have resulted in commercial successes of benefit to society. SBIR and STTR awards are selected as an integrated component of the Agency's technology strategy. This facilitates an increase in the number of NASA-funded SBIR and STTR technologies used in NASA's missions, and provide small business researchers with more efficient infusion paths for viable products.

NASA's CSTD activities span from early-stage conceptual studies to flight demonstration. CSTD uses competitive and strategically guided processes to engage a broad array of participants, including the NASA Centers, other Government agencies, academia, and industry. CSTD activities enable quantum leaps in broadly applicable technological capability for NASA's future science and exploration missions, while being of relevance to other national needs. CSTD is grouped by TRL into three technology investment areas: Early Stage Innovation (TRL 1-3), Game Changing Technology (TRL 4-5), and Crosscutting Capability Demonstrations (TRL 6-7). NASA recognizes that each step in maturing space technologies from idea and concept inception through demonstration in a relevant environment is a significant challenge. CSTD was developed to address these concerns and create a steady pipeline of technologies for NASA's future missions.

NASA's ETD activities (TRL 4-7), now managed under Space Technology, advance the new technologies required to conduct future human missions beyond low Earth orbit. Using Center expertise and fulfilling requirements set by ESMD, these activities develop long-range, critical technologies that provide the basis for a broad set of future human exploration capabilities. Prototype systems and key capabilities are demonstrated in ground-based and laboratory testing, relevant environment flight demonstrations, and technology test beds, including the ISS. After successful demonstration of technologies, human space flight program managers can identify and baseline proven technologies as part of future deep space systems and as part of NASA's overall human exploration architecture.

Integrating ETD within Space Technology creates one robust space technology budget line, consolidates the management of NASA's space technology programs within an organization focused on technology development and mission infusion, and eliminates the potential for overlap had NASA's space technology investments been split among two accounts.

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**275.2**	**-**	**1,024.2**	**1,024.2**	**1,024.2**	**1,024.2**	**1,024.2**
SBIR and STTR	96.0	-	177.3	176.8	175.6	174.3	172.8
Partnership Development and Strategic Integration	20.3	-	19.5	19.4	19.3	19.1	19.0
Crosscutting Space Technology Development	7.5	-	433.3	432.1	429.2	425.8	422.4
Exploration Technology Development	151.4	-	261.3	259.3	257.5	255.5	253.4
ST Civil Service Labor and Expenses	0.0	-	132.9	136.6	142.6	149.5	156.6

Note: FY 2010 and FY 2011 figures have been adjusted to show comparable Exploration technology content from the Exploration account, and the movement of the Innovative Partnerships Program from the Cross Agency Support account, within the Space Technology account consistent with the FY 2012 Budget. The FY 2010 level shown does not include the $51.7 million transferred to the Science and Exploration accounts, to be made available to the SBIR/STTR programs in FY 2011.

The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

In FY 2012 through FY 2016, civil service labor and expenses (CSLE) funds are administered within a single consolidated account in each of the appropriations, and not allocated within the program amounts shown above. The allocation to each program is reflected in the summary budget table included in the beginning of this budget request, which provides a full cost view. In FY 2010 and FY 2011, amounts are presented in full cost.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

In the 2011 State of the Union address, the President set a goal to "spark the creativity and imagination of our people" through increased investments in research and development, reminding the Nation that, "maintaining our leadership in research and technology is crucial to America's success." In remarks on Innovation delivered at Pennsylvania State University, the President stated, "We need you to seek breakthroughs and new technologies that we can't even imagine yet."

The economic competitiveness and high standard of living in the United States are based on decades of investment in technology and innovation. Space Technology is the central NASA contribution to a revitalized research, technology, and innovation agenda for the Nation. As a research and development agency, NASA plays a vital role in American innovation, thus, its future economic prosperity and security. Space Technology investments will stimulate the economy and build the Nation's global economic competitiveness through the creation of new products and services, new business and industries, and high-quality, sustainable jobs.

NASA's focus on technology and innovation leverages the skills and expertise of NASA's Centers, industry, academia and other Government partners. It provides knowledge and capabilities required to for future missions in science and exploration, and addresses significant national needs. By investing in space technology, NASA affects and improves life on Earth every day. It creates energy management systems on spacecraft, monitoring the health of astronauts as they explore, and observing the weather on other planets.

An enhanced technology and innovation focus at NASA responds to the recommendations of multiple stakeholders, including Congress and the National Academies. In 2010, the President released the U.S. Space Policy, affirming the importance of space technology investments. In the NASA Authorization Act of 2010, Congress directed development of a National Space Technology Policy to guide the space technology development programs for the United States. This policy will further guide NASA's technology portfolio through an integrated national approach.

Relevance to the NASA Mission and Strategic Goals:

NASA's transformative technology development activities funded through Space Technology advance the Agency and industry capabilities for exploring space. NASA leads strategic planning, integration, and coordination of civilian aerospace technology investments for the Nation.

Space Technology specifically addresses the national policies and needs encompassed by NASA's Strategic Goal 3, to "Create the innovative new space technologies for our exploration, science, and economic future."

With a strong focus on technology development, the intellectual capital at NASA's Centers will be utilized to deliver solutions to some of the Nation's technological challenges. Through its space technology efforts, NASA will improve the Nation's leadership in key technology areas, enable far-term capabilities and spurring advanced technology development that will ultimately make the exploration and utilization of space more affordable and sustainable.

Relevance to education and public benefits:

Space Technology will inspire a new generation of students, and launching career interests resulting in young engineers, scientists, technologists, and mathematicians that are able to address future national needs. Space Technology activities leverage expertise and resources with partners, drive new sources and methods of innovation, and maximize benefits to taxpayers. For example, Space Technology graduate fellowships support graduate and doctoral student researchers enrolled in a U.S. university. Students with promising initial graduate research may apply to have their work sponsored and integrated into Space Technology activities. Selected candidates will perform research on campus, and visit NASA Centers, not-for-profit research and/or development laboratories. A NASA researcher will act as the student's professional advisor. In 2012, this program element will reach its goal of actively engaging 500 graduate students per year.

These Space Technology education activities are integrated in the Agency's overall education plan through participation in the NASA Education Coordinating Council. NASA seeks activities such as these as integral to the Administration's strategy of creating a world-class workforce to develop the leading ideas and innovations of the 21st century.

Investments in Space Technology will stimulate the economy and build our Nation's global economic competitiveness through the creation of new products and services, new business and industries, and high-quality, sustainable jobs. A technology-driven NASA positions our Nation's aerospace community as a global technological leader and serves as an inspiration for young people to pursue science, technology, engineering, and mathematics (STEM) education and career paths. As demonstrated over many years, advanced technologies needed for space exploration stimulate the development of new products and services that improve our Nation's economic competitiveness and standard of living. Knowledge provided by weather and navigational spacecraft flying overhead; efficiency improvements in ground and air transportation; biomedical applications including blood-flow monitoring devices, pacemakers, Lasik eye surgery; and the protective armor that keeps our military, firefighters and police safe. Our Nation's investments in aerospace technology made these possible. By investing in Space Technology, NASA improves the quality of life on Earth.

Mission Directorate:	Space Technology
Theme:	Space Technology

Performance

Performance Commitments:

Measure #	Description	Contributing Program (s)
Strategic Goal 3	**Create the innovative new space technologies for our exploration, science, and economic future.**	
Outcome 3.1	**Sponsor early-stage innovation in space technologies in order to improve the future capabilities of NASA, other government agencies, and the aerospace industry.**	
Objective 3.1.1	**Create a pipeline of new low Technology Readiness Levels (TRL) innovative concepts and technologies for future NASA missions and national needs.**	
Performance Goal 3.1.1.1	***Explore revolutionary aerospace concepts, with an initial research phase for preliminary assessment of a broad range of ideas, and a second phase for further development of the most promising concepts.***	
APG 3.1.1.1: ST-12-1	Initiate Phase II studies to further develop two of the most promising prior (FY 2011 and predecessor NASA Institute for Advanced Concepts (NIAC)) Phase I concepts.	Crosscutting Space Technology Development
Performance Goal 3.1.1.2	***Provide cash prize incentives to non-traditional sources for innovations of interest and value to NASA and the Nation.***	
APG 3.1.1.2: ST-12-2	Conduct at least three Centennial Challenges competitions.	Crosscutting Space Technology Development
Performance Goal 3.1.1.3	***Establish and maintain a culture of innovation at each of the 10 NASA Centers through the development of new Center ideas and technologies.***	
APG 3.1.1.3: ST-12-3	Twenty innovative projects will be initiated across the NASA Centers.	Crosscutting Space Technology Development
Performance Goal 3.1.1.4	***Increase the proportion of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies successfully infused into NASA programs/projects.***	
APG 3.1.1.4: ST-12-4	At least 25 percent of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase II technology projects awarded between 2007-2011 will be infused into NASA programs and projects.	SBIR and STTR
Performance Goal 3.1.1.5	***Increase the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase III contracts initiated or expanded.***	
APG 3.1.1.5: ST-12-5	At least 40 of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies will be advanced to Phase III (received non-SBIR/STTR funding).	SBIR and STTR
Performance Goal 3.1.1.6	***Accelerate the development of push technologies to support the future space, science and exploration needs of NASA, other government agencies, and the commercial space sector.***	
APG 3.1.1.6: ST-12-6	Complete 100 research plans.	Crosscutting Space Technology Development

Mission Directorate:	Space Technology
Theme:	Space Technology

Performance

Performance Commitments:

Measure #	Description	Contributing Program (s)
Outcome 3.2	**Infuse game changing and crosscutting technologies throughout the Nation's space enterprise to transform the Nation's space mission capabilities.**	
Objective 3.2.1	**Prove the technical feasibility of potentially disruptive new space technologies for future missions.**	
Performance Goal 3.2.1.1	***Transition developed game changing technologies to the technology demonstration programs or directly to Mission Directorates for mission insertion.***	
APG 3.2.1.1: ST-12-7	Initiate five game changing technology projects.	Crosscutting Space Technology Development
Objective 3.2.2	**Spur the development of routine, low-cost access to space through small payloads and satellites.**	
Performance Goal 3.2.2.1	***Mature technologies that enable small satellites to provide game changing capabilities for the government and commercial space sectors.***	
APG 3.2.2.1: ST-12-8	Initiate development of at least two new technologies with game changing potential for small satellites.	Crosscutting Space Technology Development
Objective 3.2.3	**Demonstrate new space technologies and infuse them into future science and exploration small satellite missions and/or commercial use.**	
Performance Goal 3.2.3.1	***Demonstrate small satellite capabilities with game changing and crosscutting potential for the government and commercial space sectors.***	
APG 3.2.3.1: ST-12-9	Initiate at least one new small satellite mission that will demonstrate game changing or crosscutting technologies in space.	Crosscutting Space Technology Development
Objective 3.2.4	**Demonstrate new space technologies and infuse them into missions.**	
Performance Goal 3.2.4.1	***Infuse game changing and crosscutting technologies into future NASA missions through flight or relevant environment demonstrations.***	
APG 3.2.4.1: ST-12-10	Complete preliminary design of at least two system-level technologies for flight or relevant environment demonstration.	Crosscutting Space Technology Development
Objective 3.2.5	**Provide flight opportunities and relevant environments to demonstrate new space technologies.**	
Performance Goal 3.2.5.1	***Perform sub-orbital, simulated zero-gravity and other space analog flight opportunities to develop and demonstrate emerging ideas and technologies.***	
APG 3.2.5.1: ST-12-11	Select and fly technology payloads from NASA, other government agencies, industry, and academia using flight services procured from at least three commercial reusable suborbital and parabolic platform providers.	Crosscutting Space Technology Development

Performance

Performance Commitments:

Measure #	Description	Contributing Program (s)
Outcome 3.3	**Develop and demonstrate the critical technologies that will make NASA's exploration, science, and discovery missions more affordable and more capable.**	
Objective 3.3.1	**Demonstrate in-space operations of robotic assistants working with crew.**	
Performance Goal 3.3.1.1	***Demonstrate robotic technologies that support in-space operations, scientific discovery, and work as assistants with the crew.***	
APG 3.3.1.1: ERD-12-8	Demonstrate Robonaut 2 assisting the crew to perform tasks inside the ISS.	Exploration Technology Development
Objective 3.3.2	**Develop and demonstrate critical technologies for safe and affordable cargo and human space exploration missions beyond low Earth orbit.**	
Performance Goal 3.3.2.2	***Develop technologies and mission concepts for demonstrating in-space cryogenic propellant storage and transfer making exploration and science missions more affordable and capable.***	
APG 3.3.2.1: ST-12-12	Test automated fluid couplings for cryogenic propellant transfer to support Cryogenic Propellant Storage And Transfer (CRYOSTAT) systems requirements.	Exploration Technology Development
Outcome 3.4	**Facilitate the transfer of NASA technology and engage in partnerships with other government agencies, industry, and international entities to generate U.S. commercial activity and other public benefits.**	
Objective 3.4.1	**Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and national interests.**	
Performance Goal 3.4.1.1	***Establish 12 technology-related significant partnerships that create value for programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g., reduced volume or mass, improved safety) per year.***	
APG 3.4.1.1: ST-12-13	Establish at least 12 technology-related significant partnerships during FY 2012.	Partnership Development and Strategic Integration
Performance Goal 3.4.1.2	***Complete 30 technology transfer agreements with the commercial and academic community through such mechanisms as licenses, software use agreements, facility use agreements, and Space Act Agreements per year.***	
APG 3.4.1.2: ST-12-14	Complete at least 30 technology transfer agreements during FY 2012.	Partnership Development and Strategic Integration

Mission Directorate:	Space Technology
Theme:	Space Technology

Performance

Performance Commitments:

Measure #	Description	Contributing Program (s)
Performance Goal 3.4.1.3	***Successful application of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies into commercial products or services.***	
APG 3.4.1.3: ST-12-15	Greater than 35 percent of the Phase II Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technology projects awarded between 2007-2011 will be transferred into commercial products or services.	SBIR and STTR
Performance Goal 3.4.1.4	***Document 40-50 of the most notable examples of successful transfer and commercialization of NASA-derived technology per year and publish in Spinoff annually.***	
APG 3.4.1.4: ST-12-16	Document at least 40 notable technology transfer successes in NASA's Spinoff publication.	Partnership Development and Strategic Integration
Performance Goal 3.4.1.5	***Document, coordinate, and prioritize Agency-level technology strategic investments to ensure NASA has a balanced portfolio of both near-term NASA mission (pull) technologies and longer-term transformational (push) technologies that benefit both Agency programs and national needs.***	
APG 3.4.1.5: ST-12-17	Ensure that 75 percent of all NASA technology projects are recorded in the portfolio database and are analyzed against the prioritizations in the space technology roadmaps.	Partnership Development and Strategic Integration

Uniform and Efficiency Measures:

Measure #	Description
Space Technology Theme	
APG EFF 3.4.1.5: ST-12-17	Ensure that 75 percent of all NASA technology projects are recorded in the portfolio database and are analyzed against the prioritizations in the space technology roadmaps.

Performance Achievement Highlights:

NASA conducted low-level planning activities, including issuing requests for information for budgeted elements of the FY 2011 Space Technology Theme, and received approximately 1,400 responses.

NASA hosted a Space Technology Industry Forum with over 300 external participants and announced three new Centennial Challenges. Competitive solicitations, including NASA research announcements research announcements (NRA) and broad Agency announcements (BAAs), have been prepared for all CSTD projects.

The Space Technology Graduate Fellowship solicitation was released, allowing graduate students from across the Nation, whose research interests are aligned with the 14 space technology roadmap areas, to participate in NASA Space Technology activities. NASA expects to announce the Space Technology fellows in August 2011.

In FY 2010, Innovative Partnerships Program (IPP) was integrated into Space Technology. IPP successes include more than 1,400 new invention disclosures on NASA-funded technology that could lead to patents and technology transfer, and broad dissemination of about 600 of those through NASA's TechBriefs magazine. NASA civil servant innovators were recognized by the Wall Street Journal, R&D Magazine, the Federal Laboratory Consortium and others.

As part of intellectual property management activities, eighty patent applications were filed and awarded in FY 2010. NASA has continued its initiative to generate licenses for NASA technologies through an auctioning intermediary at no cost to NASA.

NASA entered into over 300 Space Act Agreements with private and other external entities for development of dual-use technologies that have applications that meet NASA's technology needs.

In FY 2010, at least 68 technologies were infused into various NASA programs from IPP. Infused technologies fly on NASA missions during the year, are adopted for use in future systems, or are chosen by the Mission Directorates for further development.

Forty-one Innovation Fund projects were selected to encourage NASA civil servant innovators to create breakthrough technologies. NASA funding for select projects was matched by $800,000 in external partner contributions.

Commercial parabolic flight services were provided for 17 projects involving external and internal entities that could take advantage of limited exposure to reduced gravity to mature NASA mission-relevant technologies.

ETD developed manufacturing concepts for 10 meter diameter heavy-lift launch vehicle composite structures, flight testing of laser and optical sensors for autonomous precision landing and hazard avoidance, ISS demonstration of precision free flying remote manipulators, in-situ resource utilization field tests, and the evaluation of operational scenarios for future surface exploration missions.

Robonaut 2, or R2, is ready for launch to the ISS on Space Shuttle Discovery as part of the STS-133 mission. R2 will become the first dexterous humanoid robot in space and the first U.S.-built robot at the ISS.

The Mars Science Laboratory Entry, Descent, and Landing Instrument (MEDLI) is currently undergoing final testing, calibration, and integration into the Mars Science Laboratory in preparation for launch in late 2011.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	National Academies	01/2011	NASA's 14 space technology roadmaps consider a wide range of pathways to advance the Nation's current capabilities. NASA developed the set of draft roadmaps for use by the National Academies as an initial point of departure for mapping the Agency's future investments in technology. This independent review by the National Academies will facilitate development of the National Space Technology Policy called for in the NASA Authorization Act of 2010.	03/2012

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	SBIR and STTR

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**96.0**	**-**	**177.3**	**176.8**	**175.6**	**174.3**	**172.8**
SBIR and STTR	96.0	-	177.3	176.8	175.6	174.3	172.8

Note: Included in this total request ($177.3 million) for SBIR and STTR are both the estimated total award values ($173.3 million) and funding ($4 million) necessary for the program operations and support. The FY 2010 level shown does not include the $51.7 million transferred to the Science and Exploration accounts, to be made available to the SBIR/STTR programs in FY 2011.

The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

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Program Overview

NASA's SBIR and STTR programs continue to support early-stage research and development by small businesses through competitively awarded contracts. These programs continue to produce innovations for both government and commercial applications.

SBIR and STTR programs are implemented under the Space Technology Theme, with the dual objectives of providing the high technology small business sector with an opportunity to develop technology for NASA and commercializing that technology to spur economic growth. These technologies have extended their reach beyond NASA's missions, contributing to commercial successes that ultimately result in marketable products and societal benefits.

Research and technologies funded by SBIR and STTR have made important contributions to numerous NASA programs and projects, and the Agency is actively working to increase the number of NASA-funded SBIR and STTR technologies used in NASA's missions and projects. Some of NASA's high-profile programs directly benefiting from SBIR technologies include the Space Shuttle, ISS, Mars Exploration Rovers, and the Phoenix lander.

SBIR and STTR awards, and support to cover the cost of managing the program, are included in this budget. Each year, 28 to 30 percent of applicants represent firms new to NASA's SBIR and STTR Program. New participants make up 20 to 35 percent of the total number of proposals in any given year.

For more information about SBIR and STTR, please visit http://sbir.gsfc.nasa.gov/SBIR/SBIR.html.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	SBIR and STTR

Plans For FY 2012

For prior years, the maximum value and period of performance for Phase I contracts for SBIR was $100,000 over six months and for STTR was $100,000 over 12 months. For Phase II, the maximum for SBIR awards was $750,000 over 24 months and for STTR was $750,000 over 24 months.

Small Business Administration policy changes made in 2011 allow for larger maximum award sizes. Starting with the FY 2011 SBIR solicitations, Phase I awards can reach $150,000, and Phase II can reach up to $1 million. Awards for solicitations allowing this new range will be made in early to mid FY 2012.

For the FY 2012 solicitation, NASA will align SBIR and STTR topics with the space technology roadmaps and the National Aeronautics Research and Development Plan. NASA's Center Chief Technologists will coordinate between Center SBIR and STTR projects and mission needs on topic development, selection, project administration, infusion activities, and reporting processes. A Mission Directorate steering council will maximize alignment and infusion of the SBIR and STTR products into NASA's future missions and systems. This approach integrates and couples the SBIR and STTR programs as a critical component of the Agency's technology development activities, providing the small business researchers with more efficient infusion paths for viable products.

Project Descriptions and Explanation of Changes

The Small Business Innovation Research (SBIR) Program

SBIR was established by Congress in 1982 to increase research and development opportunities for small businesses with 500 or fewer employees, increase employment, and improve U.S. competitiveness. The program's specific objectives are to stimulate U.S. technological innovation, employ small businesses to meet Federal research and development needs, increase private sector commercialization of innovations derived from Federal research and development, and encourage and facilitate participation by socially disadvantaged businesses. NASA, as a mission driven agency, seeks small, high-technology companies to participate in Government-sponsored research and development efforts in technology areas critical to NASA's missions. Current authorization provides for SBIR funding at 2.5 percent of NASA's extramural research and development budget.

The Small Business Technology Transfer Research (STTR) Program

STTR awards contracts to small business concerns for cooperative research and development with a non-profit research institution, such as a university. NASA's STTR program has the primary objective of facilitating the transfer of technology developed by a research institution through the entrepreneurship of a small business, resulting in technology to meet NASA's needs. The small business and its partnering institution are required to sign an intellectual property agreement. Modeled after the SBIR program, STTR is a separately funded activity. STTR is smaller than SBIR, with funding set at 0.3 percent of the NASA extramural research and development budget.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	SBIR and STTR

Program Commitments

Commitment/Output FY 2012	Program/Project	Changes from FY 2011 PB Request
At least 25 percent of the SBIR/STTR Phase II technology projects awarded between 2007 and 2011 will be infused into NASA programs and projects.	SBIR/STTR Program	None
At least 40 of the SBIR/STTR technologies will be advanced to Phase III (received non-SBIR/STTR funding).	SBIR/STTR Program	None
Greater than 35 percent of the Phase II SBIR/STTR technology projects awarded between 2007-2011 will be transferred into commercial products or services.	SBIR/STTR Program	None

Program Management

The SBIR and STTR Program is led by OCT Program Executives at NASA Headquarters. They oversee the Level II Program Office at ARC.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR)	NASA Headquarters Program Executives. Level 2 Program Office at ARC.	All Centers	

Acquisition Strategy

The OCT Program Executives, the Level 2 Program Office, the Mission Directorates, and the Center Chief Technologists contribute to the acquisition process, from topic development, selection, project administration, and infusion activities to final reporting processes. In addition, a Mission Directorate steering council is employed to maximize alignment and infusion of the SBIR and STTR products into NASA's future missions and systems. NASA issues annual program solicitations that set forth a substantial number of topics and subtopic areas consistent with stated Agency needs or missions. Both the list of topics and the description of the topics and subtopics are sufficiently comprehensive to provide a wide range of opportunity for small business concerns to participate in NASA research or development programs. Topics and subtopics emphasize the need for proposals that meet specific Agency needs.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	National Academies	09/2009	Assessment of the SBIR program: Review is currently in Phase II of a two-phase study. Phase II results are planned for completion in early FY 2012. Phase I results have been published.	10/2011

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	Partnership Development and Strategic Integration

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**20.3**	**-**	**19.5**	**19.4**	**19.3**	**19.1**	**19.0**
Partnership Development and Strategic Integration	20.3	-	19.5	19.4	19.3	19.1	19.0

Note:

The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

In FY 2012 through FY 2016, civil service labor and expenses (CSLE) funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project amounts shown above. The allocation to each project is reflected in the summary budget table included in the beginning of this budget request, which provides a full cost view. In FY 2010 and FY 2011, amounts are presented in full cost.

Program Overview

Partnership Development and Strategic Integration includes the activities of the Partnerships, Innovation and Commercial Space (PICS) and the Strategic Integration (SI) offices.

The PICS office is responsible for technology transfer and commercialization, interagency coordination and joint activities, intellectual property management, and partnership opportunities with other Government agencies and commercial industry. The office represents OCT in deliberations involving innovation-related policies, pilots, and processes for NASA to ensure these policies and processes stimulate greater commercial space activities within NASA and in the United States. The Executive Secretary for the Commercial Space Subcommittee of the NASA Advisory Council (NAC) resides within PICS.

The SI office works with the Mission Directorates and NASA Centers to develop an Agency technology portfolio and coordinate Agency technology investments. Consistent with the NASA Authorization Act of 2010, SI focuses on aligning NASA's technology investments to ensure that Space Technology complements Mission Directorate investments. SI is responsible for Agency technology strategic planning activities including technology roadmapping and serves as the primary point of collaboration for Mission Directorates, Mission Support Offices, and Center Chief Technologists. The Executive Secretary for the NAC Technology and Innovation Committee, NASA Technology Executive Council (NTEC), and Chief Technologist Council (CTC) reside within SI and support OCT representation to various Agency leadership panels.

Plans For FY 2012

PICS continues to support partnership opportunities with industry, academia, other Government agencies, and international entities. These activities include managing NASA's intellectual property from identifying new inventions to documenting and facilitating the patent process, to seeking partners to license the technology. NASA also seeks other opportunities for technology transfer through partnership agreements and release of software for public use. Partnership development activities continue to identify and demonstrate strategic areas of innovation with potential benefit to NASA.

To further energize new commercial space capabilities and industries, NASA will analyze, coordinate, and facilitate emerging commercial space efforts across the Agency and provide a NASA "front door" to new entrepreneurial space firms with a new Level 2 office at Ames Research Center (ARC).

In FY 2012, SI continues to carry out strategic technology planning, conduct technology studies, and coordinate Agency-level technology investments. SI will implement a system to capture and track NASA's technology portfolio, identify synergies and gaps, and ensure that the technology portfolio aligns with the technology investments and priorities documented in the NASA space technology roadmaps. SI continues development of the space technology roadmaps in cooperation with the National Academies; disseminates quarterly and annual technology reports; identifies and updates the Space Technology Grand Challenges; and guides prioritization for future technology development.

Project Descriptions and Explanation of Changes

Partnerships Innovation & Commercial Space (PICS)

PICS funds technology partnership activities at all NASA Centers. These Center offices carry out program support functions to facilitate Center-based technology transfer, innovative partnerships and commercialization activities.

Partnership activities focus on stimulating economic growth through technology transfer and access to NASA expertise, leveraging the technology investments of other Government agencies, connecting with industry technologists to permit utilization of NASA facilities, and expanding relationships with state, local, and regional technology-based economic development agencies.

Innovation activities identify strategic areas with potential benefit to NASA. In particular, NASA addresses gaps identified through technology roadmapping activities and seeks to increase the exchange of ideas with the most innovative segments of the private sector and Government. This is accomplished in several ways: piloting projects to explore how new methods and practices in innovation may be of benefit to NASA; appointing Innovation Ambassadors (i.e., NASA employees placed at external innovative organizations for up to 12 months); conducting one to two-day "Innovation Scouts" workshops that enable the exchange of information on innovation; bringing proven start-up entrepreneurs to NASA Centers to help develop business cases for promising NASA technologies; and engaging from leading experts in innovation.

Commercial space activities analyze, coordinate, and facilitate emerging commercial space capabilities and industries in support of NASA's missions, promoting economic growth, and improving national security. This is done by working with entrepreneurs across the aerospace industry to enable new commercial space capabilities similar to the way NASA's predecessor, the National Advisory Committee on Aeronautics (NACA), aided the early aeronautics industry, while leveraging ongoing NASA activities such as ISS utilization and the Commercial Orbital Transportation Services (COTS) and Commercial Crew Development (CCDEV) Programs. NASA will promote new business practices and collaboration models within NASA to lower cost and provide value to the American taxpayer while assessing, leveraging and facilitating the expansion of commercial capabilities into new areas, including commercial in-space servicing.

Strategic Integration (SI)

Strategic Integration works with the Mission Directorates and NASA Centers to document the Agency's technology portfolio, identify gaps, identify potential areas of synergy, collect information, and conduct decision-making studies that guide future technology investments. SI develops two sets of strategic guidance documents that assist in Agency technology prioritization. First, NASA uses the independent guidance provided by the STR, an integrated set of roadmaps from 14 space technology areas that includes near-term mission-focused technology and longer-term transformational technology. Second, NASA uses the Space Technology Grand Challenges, a set of technically challenging, strategic, space-related goals that push the Nation's technology boundaries and provide a guide to a stronger and more vibrant future for the Nation in space.

SI conducts focused studies, working group meetings, and development activities with NASA Mission Directorates, Centers, Agency partners, academia, and industry. SI disseminates information and coordinates technology development and infusion activities that are closely aligned with NASA missions and support national needs. SI organizes and coordinates the NTEC meetings, and the CTC, both chaired by the NASA Chief Technologist.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	Partnership Development and Strategic Integration

Program Commitments

Commitment/Output FY 2012	Program/Project	Changes from FY 2011 PB Request
Establish at least 12 technology-related significant partnerships during FY 2012.	Partnership Development and Strategic Integration/PICS	None
Complete at least 30 technology transfer agreements during FY 2012.	Partnership Development and Strategic Integration/PICS	None
Document at least 40 notable technology transfer successes in NASA's Spinoff publication.	Partnership Development and Strategic Integration/PICS	None
Ensure that 75 percent of all NASA technology projects are recorded in the portfolio database and are analyzed against the prioritizations in the space technology roadmaps.	Partnership Development and Strategic Integration/SI	None

Program Management

The PICS and Strategic Integration offices are based at NASA Headquarters. Both programs work with technology partnership offices and the chief technologists at each NASA Center.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
PICS	Partnerships, Innovation and Commercial Space Director, NASA Headquarters	Technology Partnership Offices at all NASA Centers	N/A
Emerging Commercial Space Opportunities	NASA HQ program executive. ARC Level 2 Program Office facilitates emerging commercial space efforts.	All NASA Centers	N/A
Strategic Integration	Strategic Integration Director, NASA Headquarters	Center Chief Technologist Offices at all NASA Centers	N/A

Acquisition Strategy

A majority of the Partnership Development procurement activities are distributed to the NASA Centers for competitively selected contract support to their technology partnership offices. NASA uses novel approaches to facilitate technology transfer, as ensuring technologies are infused into commercial applications will promote the creation of new jobs and advance new products and services that will benefit the Nation.

Strategic Integration activities are accomplished by NASA Headquarters and the NASA Centers. Guidance is provided by the NASA Mission Directorates through the NTEC, and from the NASA Centers through the CTC. There are minimal procurement activities associated with this Agency technology coordination and strategic planning function.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	Crosscutting Space Technology Development

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**7.5**	**-**	**433.3**	**432.1**	**429.2**	**425.8**	**422.4**
Crosscutting Space Tech Development	7.5	-	433.3	432.1	429.2	425.8	422.4

Note:
The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

In FY 2012 through FY 2016, civil service labor and expenses (CSLE) funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project amounts shown above. The allocation to each project is reflected in the summary budget table included in the beginning of this budget request, which provides a full cost view. In FY 2010 and FY 2011, amounts are presented in full cost.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	Crosscutting Space Technology Development

Program Overview

CSTD invests in a diversified technology development portfolio that spans the TRL spectrum from concept study to flight demonstration, enabling revolutionary space capabilities. These activities focus on broadly applicable technologies, designed to enable quantum leaps in technological capability. NASA's Mission Directorates, other Government agencies, and industry are the ultimate customers for CSTD products. Within this program, there are three investment areas: Early Stage Innovation, Game Changing Technology, and Crosscutting Capability Demonstrations.

Within Early Stage Innovation, NASA sponsors a wide range of advanced aerospace system concept and foundational technology development (TRL 1-3) efforts. This includes the following four projects: Space Technology Research Grants that provide both foundational research in space technology and fellowships for graduate student research in space technology, NASA Innovative Advanced Concepts (NIAC), which engages innovators within and external to the Agency on aerospace system concept studies, a Center Innovation Fund to stimulate aerospace creativity and innovation at the NASA Centers, and Centennial Challenges Prizes that address key technology needs through new sources of innovation outside the traditional aerospace community.

Within Game Changing Technology, NASA focuses on maturing potentially transformational technology across the critical mid-TRL (3-5) gap between Early Stage Innovation and flight demonstration of a new technology. These fixed duration, principal investigator-led project elements are managed within two projects: Game Changing Development, which seeks disruptive technologies for future science and exploration missions, and Franklin Small Satellite Subsystem Technologies, which seeks innovation in subsystems for small satellites. Within Game Changing Technology, success is not expected with each investment; however, on the whole and over time, dramatic advances in space technology enabling entirely new NASA missions and solutions for a wide variety of society's grand technological challenges are expected and will be measured.

Within Crosscutting Capability Demonstrations, NASA demonstrates technologies that benefit multiple NASA missions, other Government agencies, or the space industry. This investment area matures new technology to flight readiness status (TRL 6-7) via three projects: Technology Demonstration Missions that demonstrate crosscutting technologies in the space environment, Edison Small Satellite Demonstration Missions that develop and operate a series of small satellite demonstration missions, and Flight Opportunities, which matures technologies by providing access to the space environment while also facilitating the development of the commercial reusable suborbital transportation industry.

Plans For FY 2012

Within Early Stage Innovation, NASA will initiate Phase II NIAC studies to further develop at least three of the most promising NIAC Phase I concepts from FY 2011 and predecessor NIAC efforts. An additional round of NIAC Phase I studies will be awarded resulting in at least 12 new NIAC efforts. In FY 2012, NASA will reach its goal of supporting 500 Space Technology Graduate Fellows from the Nation's universities. In addition, NASA will conduct at least three new Centennial Challenges competitions and initiate a wide range of innovative projects across the NASA Centers through the Center Innovation Fund. NASA also plans to release NRAs and make awards for approximately 40 new foundational space technology research activities. All Early Stage Innovation activities are competitively selected.

Within Game Changing Technology, the Game Changing Development project consists of both strategically guided and competed project elements. In FY 2012, the following four guided project elements are initiated: Nanotechnology, Deep Space Navigation and Communication, Space Synthetic Biology, and Manufacturing Innovation. Additionally, NASA expects to competitively award at least five Game Changing Development activities that augment the four project elements listed above or begin new crosscutting space technology development project elements. NASA will also competitively select at least three new project elements through the Franklin Small Satellite Subsystem Technology project.

Within Crosscutting Capability Demonstrations, the Technology Demonstration Missions and Edison Small Satellite Demonstration Missions projects consist of both strategically guided and competed project elements. In FY 2012, NASA will continue development of the Low Density Supersonic Decelerator Technology Demonstration Mission project element, transitioning this project element from formulation to implementation contingent on the results of the FY 2011 Mission Concept Review. In FY 2012, NASA plans to complete preliminary design of two competitively selected Technology Demonstration Mission project elements of system-level technologies for relevant environment flight demonstration. In FY 2012, at least three new small satellite missions will be initiated within Edison Small Satellite Demonstration Missions, with at least one of these missions being led by ARC. In Flight Opportunities, NASA will select and fly technology payloads from NASA Centers, other Government agencies, industry, and academia using flight services procured from at least three commercial reusable suborbital and parabolic platform providers. In this project element, in-space flight demonstrations are pursued not only as standalone missions, but also using planned NASA missions, the ISS, and commercial and international partner space platforms (e.g., hosted payloads or missions of opportunity).

Project Descriptions and Explanation of Changes

Game Changing Development project elements

Nanotechnology- Led by Glenn Research Center (GRC), this project element will include advancing nanotechnology research and applications for space technology, including nanomanufacturing, nanoelectronics, and nanoenhanced solar energy conversion. It also includes continued development of the Nano Energetics Propulsion effort led by the Marshall Space Flight Center (MSFC).

Deep Space Navigation and Communication- High bandwidth communications and advanced navigation capabilities will enable future deep space exploration of the solar system and pinpoint navigation in near-Earth space. This project element includes research in optical, X-ray, and other approaches to achieve high bandwidth communications and navigation activities. This project element is led by Space Communications and Navigation (SCaN) at NASA Headquarters and will involve both the Goddard Space Flight Center (GSFC) and the Jet Propulsion Laboratory (JPL).

Space Synthetic Biology- Biology readily demonstrates that life is an efficient user of resources around it, turning those resources into habitats, materials and forms that perform a wide range of functions efficiently. This project element, which will be led by the Ames Research Center (ARC), researches a range of genomics and synthetic biology approaches for the design of organisms to perform reliable functions for future human and robotic exploration activities.

Manufacturing Innovation- This project element, led by GRC, includes innovation in rapid prototyping for low-cost manufacturing, including algorithm and software development for modeling and simulation to streamline the design to manufacturing pipeline.

Through release of a BAA open to industry, academia, and the NASA Centers, NASA expects to competitively award at least five additional Game Changing Development activities that either augment the four project elements listed above or begin new project elements of a crosscutting space technology development nature.

Technology Demonstration Missions project elements

Low Density Supersonic Decelerator Technology Demonstration Mission- To safely land high-mass payloads on planetary surfaces, particularly for higher surface elevation landing sites, advances in supersonic decelerator technology are required. This project element (led by JPL) designs, develops and tests a range of supersonic decelerator technologies at high altitude on Earth (i.e., Mars relevant environment conditions). This project element will transition from formulation to implementation in FY 2012, contingent on the results of a Mission Concept Review in FY 2011. In FY 2012, NASA plans to complete preliminary design of at least one competitively selected Technology Demonstration Mission project of system-level technologies for relevant environment flight demonstration and initiate development of at least two additional Technology Demonstration Missions. These Technology Demonstration Mission activities will be undertaken to begin new project elements of a crosscutting space technology development nature.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	Crosscutting Space Technology Development

Program Commitments

Commitment/Output FY 2012	Program/Project	Changes from FY 2011 PB Request
Initiate Phase II studies to further develop two of the most promising prior (FY 2011 and predecessor NASA Institute for Advanced Concepts (NIAC)) Phase I concepts.	NASA Innovative Advanced Concepts Program (NIAC)	None
Conduct at least three Centennial Challenges competitions.	Centennial Challenges (CC)	None
Initiate at least five game changing technology projects.	Game Changing Development (GCD)	None
Complete preliminary design of at least two system-level technologies for flight or relevant environment demonstration.	Technology Demonstration Missions	None
Select and fly technology payloads from NASA, other government agencies, industry and academia using flight services procured from at least three commercial reusable suborbital and parabolic platform providers.	Flight Opportunities	None
Initiate at least 20 innovative projects across the NASA Centers.	Center Innovation Fund (CIF)	None
Initiate at least one new small satellite mission that will demonstrate game changing or crosscutting technologies in space	Edison Small Satellite Demonstration Missions	None
Initiate development of at least two new technology with game changing potential for small satellites.	Franklin Small Satellite Subsystem Technologies	None
Complete 100 research plans.	Space Technology Research Grants (STRG)	None

Program Management

Management responsibility for project elements from CSTD and ETD are performed in an integrated manner.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Center Innovation Fund	NASA HQ program executive. Center Chief Technologists will competitively select projects.	All Centers	
Centennial Challenges	NASA HQ program executive. MSFC Level 2 Program Office implements innovative prize program.	N/A	
NASA Innovative Advanced Concepts (NIAC)	NASA HQ program executive will manage conduct of visionary, long-term concept studies.	All Centers	
Space Technology Research Grants	NASA HQ program executive. GRC Level 2 Program Office manages foundational research.	All Centers	
Franklin Small Satellite Subsystem Technologies	NASA HQ program executive. ARC Level 2 Program Office manages subsystem technology efforts.	All Centers	
Game Changing Development	NASA HQ program executive. LaRC Level 2 Program Office fosters revolutionary technology.	All Centers	
Technology Demonstration Missions	NASA HQ program executive. MSFC Level 2 Program Office manages crosscutting technology flight test.	All Centers	
Edison Small Satellite Demonstrations	NASA HQ program executive. ARC Level 2 Program Office manages demonstration missions.	All Centers	
Flight Opportunities	NASA HQ program executive. DFRC Level 2 Program Office manages flight platforms.	All Centers	

Acquisition Strategy

To achieve the Agency's technology goals, the Crosscutting Space Technology Development (CSTD) program is implemented predominantly through a technical peer review, open competition acquisition approach, with solicitations open to the broad aerospace community to ensure engagement with the best sources of new and innovative technology. As such, CSTD will be performed by the Nation's highly skilled workforce in industry, academia, across all NASA Centers, and in collaboration with other Government agencies. Awards will be made based on technical merit, cost, and impact to the Nation's future space activities. NASA's Mission Directorates, other Government agencies, and industry are the ultimate customers for Crosscutting Space Technology Development products.

To increase competition within CSTD solicitations, NASA plans to engage potential partners using industry forums, requests for information, and bidder's conferences. NASA uses acquisition mechanisms such as BAAs, NRAs, and prize competitions.

All selections in Early Stage Innovation and 70 percent of Game Changing Development and Crosscutting Capabilities Demonstrations are competitively awarded. NASA has partnered with Defense Advanced Research Projects Agency (DARPA) to share lessons learned. In FY 2012, additional Government agency partners are likely. CSTD Technology Demonstration Missions require proposers to partner with entities (external to CSTD) to cost share a minimum of 25 percent of the proposed development effort in demonstrating a credible infusion path. Flight Opportunities solicitations will be focused on facilitating the development of the commercial reusable suborbital transportation industry. This is an important step in the longer-term path that envisions suborbital reusable launch vehicles evolving to provide the Nation with low-cost, frequent, reliable access to orbital space.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	Exploration Technology Development

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**151.4**	**-**	**261.3**	**259.3**	**257.5**	**255.5**	**253.4**
Exploration Technology Development	151.4	-	261.3	259.3	257.5	255.5	253.4

Note:

The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended). Amounts in the "Ann. CR FY 2011" column reflect the annualized level provided by the Continuing Resolution.

In accordance with the President's proposal to implement a five-year non-security discretionary spending freeze, budget figures shown for years after FY 2012 are notional and do not represent policy. Funding decisions will be made on a year-by-year basis.

In FY 2012 through FY 2016, civil service labor and expenses (CSLE) funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project amounts shown above. The allocation to each project is reflected in the summary budget table included in the beginning of this budget request, which provides a full cost view. In FY 2010 and FY 2011, amounts are presented in full cost.

Program Overview

In FY 2012, NASA has moved a significant portion of the FY 2010 ETD, as well as the planned FY 2011 exploration technology activities, from ESMD to Space Technology in order to capitalize on the synergy between these activities and those in the Crosscutting Space Technology Development. For traceability, the transferred activities have been consolidated in a specific budgetary element within Space Technology: ETD. ETD activities provide the long-range, critical technologies required to conduct future human exploration missions beyond low Earth orbit with reduced risk and life cycle cost. Through ETD, exploration-specific prototype systems and key capabilities are demonstrated in ground-based and laboratory testing, relevant environment flight demonstrations, and technology test beds, including the ISS. ETD focuses on the highest priority technology needs identified in NASA's recent human exploration mission architecture studies. ESMD is the primary customer for ETD advances. By moving a majority of the Agency's exploration-specific technology development activities from ESMD to Space Technology, NASA better integrates its space technology portfolio, gains management and technical synergies, and places the management of these activities within an organization focused upon technology development and infusion.

NASA will continue to manage ETD through both strategically guided and competed project elements. The guided project elements will focus upon key Agency technology priorities identified in recent human exploration mission architecture studies, leveraging the existing technical strength of the NASA Centers. The competed project elements will focus on enabling exploration technologies that either augment the guided project elements or begin new project elements with an exploration-specific technology demonstration focus.

ETD consists of two projects: Exploration-specific Game Changing Development and Exploration-specific Technology Demonstration Missions. ETD seeks disruptive technologies for future human exploration missions to multiple destinations, including the Moon, Lagrange points, near Earth asteroids, and Mars and its moons. After successful maturation of these critical technologies, program managers can identify and baseline proven technologies for future ESMD human space flight systems.

Plans For FY 2012

ETD will continue most of the investments from the FY 2010 Exploration Technology Development Program and includes new exploration technology activities in planning in FY 2011. The transferred activities have been consolidated within two projects in ETD: Exploration-specific Game Changing Development and Exploration-specific Technology Demonstration Missions. Capitalizing on technical and management synergies, NASA plans to manage ETD and CSTD in an integrated manner. Customer focus, the balance between competed/guided project elements, and cost-share requirements are the differentiating characteristics of ETD and CSTD. In FY 2012, 70 percent of the funds within ETD will be applied to guided activities.

Within ETD, FY 2010 Exploration Technology Development Program activities and FY 2011 plans have been organized into the following nine FY 2012 Exploration-specific Game Changing Development project elements: In-Space Propulsion, Space Power Generation and Storage, Nuclear Systems, Lightweight Materials and Structures, Human-Robotic Systems, Autonomous Systems, Next-Generation Life Support, Adaptive Entry Systems, and In-Situ Resource Utilization. In addition, in FY 2012, NASA will release a BAA open to industry, academia, and the NASA Centers for additional exploration-specific Game Changing Development activities. NASA expects to competitively award at least seven activities that either augment the nine project elements listed above or begin new project elements with an exploration-specific technology development focus.

In FY 2012, NASA will continue development of the following FY 2010 Exploration Technology Development Program activities and FY 2011 plans through five Exploration-specific Technology Demonstration Mission project elements: Human Exploration Telerobotics, Mars Science Laboratory Entry, Descent, and Landing Instrumentation (MEDLI), Autonomous Landing and Hazard Avoidance Technology (ALHAT), Cryogenic Propellant Transfer and Storage, and Solar Electric Propulsion. The Cryogenic Propellant Transfer and Storage and Solar Electric Propulsion project elements will complete Phase A concept studies in FY 2011. Based on the results of these concept study efforts, these two Exploration-specific Technology Demonstration Missions will transition from formulation to implementation in either FY 2012 or FY 2013.

Project Descriptions and Explanation of Changes

Exploration-specific Game Changing Development project elements:

In-Space Propulsion: This project element, led by GRC, will focus on the component low-thrust and high-thrust propulsion technology advances necessary for efficient transfer into deep space.

Space Power Generation and Storage: This project element, led by GRC, will develop technologies to provide low-cost, abundant power for deep-space missions (and dual-use terrestrial applications), including high-efficiency solar cells, advanced batteries and regenerative fuel cells.

Nuclear Systems: This project element, led by GRC, will test power conversion and thermal management technologies for in-space nuclear power and propulsion systems. Non-nuclear testing will validate the performance of integrated systems. NASA will partner with DOE in this development.

Lightweight Materials and Structures: This project element, led by LaRC, will develop advanced materials and structures technology to enable lightweight systems to reduce mission cost. As part of this element, a composite cryogenic propellant tank activity applicable to heavy lift launch vehicles, propellant depots, and future lander systems will be led by MSFC.

Human-Robotic Systems: This project element, led by JSC, will develop advanced robotics technology to amplify human productivity and reduce mission risk by improving the effectiveness of human-robot teams. Key technologies include human-robot interaction, robotic assistance, and surface mobility systems.

Autonomous Systems: This project element, led by ARC, will develop and demonstrate integrated autonomous systems (including automated planning, Integrated Systems Health Management [ISHM], and radiation hardened electronics) capable of managing complex operations in space to reduce crew workload and dependence on Earth.

Next-Generation Life Support: This project element, led by JSC, will develop next-generation life support systems technologies (including atmospheric revitalization, water recovery, thermal control, active radiation protection, food production, and next-generation spacesuit technologies) needed for humans to live and work productively in space.

Adaptive Entry Systems: This project element, led by LaRC, will design, analyze, and test options for development of a large aeroshell, including the use of hypersonic inflatable aerodynamic decelerators, deployable systems, and those constructed through on-orbit assembly. As part of this element, deployable systems and flexible ablative thermal protection system (TPS) activities will be led by ARC.

In-Situ Resource Utilization (ISRU): This project element will enable sustainable human exploration through use of local resources. Concepts to produce fuel, oxygen, and water from the soil and atmosphere of celestial bodies will be explored. Led by KSC.

NASA will also release a BAA open to industry, academia, and the NASA Centers through which at least seven activities that either augment the nine project elements listed above or begin new project elements with an Exploration-specific technology development focus are expected to be awarded.

Exploration-specific Technology Demonstration Missions project elements:

Human Exploration Telerobotics: This project element, led by ARC, will demonstrate safe and cooperative interactions between humans and robots. The Robonaut 2 humanoid robot and Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES) experiments on ISS will be teleoperated from the ground to assist the crew in performing hazardous or routine tasks. A standard robot control interface will be tested that allows different robots from NASA and international partners to work together.

MEDLI: The MEDLI suite is a set of engineering sensors designed to measure the atmospheric conditions and performance of the MSL heat shield during entry and descent at Mars. While not part of the core MSL scientific payload, it will provide important information for the design of entry systems for future planetary missions. This project element, led by LaRC, will be completed in 2012.

ALHAT: This project element, led by JSC, is developing technologies that will allow planetary landers to automatically identify and navigate to the location of a safe landing site while detecting landing hazards during the final descent to the surface. Technologies being testing include flash lidar for three-dimensional mapping, advanced speed measurements and algorithms. This project element will be completed in 2012.

Cryogenic Propellant Transfer and Storage: Minimizing boil-off of cryogenic propellants on long-duration missions is a critical capability needed to enable high-energy cryogenic propulsion stages, a key component of future human spaceflight architectures. This Exploration-specific Technology Demonstration Mission will, for the first time, demonstrate the capability of storing liquid oxygen and liquid hydrogen in-space for at least six months. The flight system consists of a representative cryogenic propulsion stage launched into low Earth orbit. Testing of fluid transfer between tanks is under consideration. Ongoing technology developments will include active cooling of propellant tanks, advanced thermal insulation, measurement of propellant mass, liquid acquisition devices, and automated fluid couplings for propellant transfer between vehicles. This activity, led by GRC, will transition from formulation to implementation in either FY 2012 or FY 2013, based on the results of concept study efforts conducted in FY 2011.

Solar Electric Propulsion: This near-Earth technology maturation effort, led by GRC, will demonstrate a solar electric propulsion system of sufficient power to serve as a stepping-stone to that required for the future human exploration missions. This activity will transition from formulation to implementation in either FY 2012 or FY 2013, based on the results of concept study efforts conducted in FY 2011. NASA will partner with Air Force Research Laboratory (AFRL) in this development.

Program Commitments

Commitment/Output FY 2012	Program/Project	Changes from FY 2011 PB Request
Demonstrate Robonaut 2 assisting the crew to perform tasks inside the ISS.	Exploration Technology Development	
Test automated fluid couplings for cryogenic propellant transfer to support Cryogenic Propellant Storage And Transfer (CRYOSTAT) systems requirements.	Exploration Technology Development	

Program Management

ETD and CSTD project elements are managed in an integrated manner as listed below.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Exploration-specific Game Changing Development	NASA HQ program executive. LaRC Level 2 Program Office fosters revolutionary technology.	All Centers	
Exploration-specific Technology Demonstration Missions	NASA HQ program executive. MSFC Level 2 Program Office manages crosscutting technology flight test.	All Centers	DoE, General Motors, Air Force Research Laboratory

Acquisition Strategy

A lead Center will manage each of the guided ETD project elements as a finite duration effort that will include a number of competitive procurements. For example, starting in FY 2012, NASA Centers will initiate a series of Exploration-specific Technology Demonstration Missions that will issue competitive contracts for mission development and flight demonstration support. The first two Exploration-specific missions in this line will be the CRYOSTAT and the Solar Electric Propulsion Technology Demonstration Missions, each led by GRC.

In FY 2012, 30 percent of the funds within ETD will used for competitive awards, drawing proposals from industry, academia, and the NASA Centers. Exploration-specific Game Changing Development BAA proposers will be expected to either augment the identified ETD project elements or propose high-value complementary or gap areas of ETD. Exploration-specific Technology Demonstration Missions proposers are strongly encouraged to partner and cost share with entities (external to Space Technology). However, unlike CSTD, a minimum of 25 percent cost share is not required.

Mission Directorate:	Space Technology
Theme:	Space Technology
Program:	ST Civil Service Labor and Expenses

FY 2012 Budget Request

Budget Authority ($ millions)	FY 2010	Ann CR. FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
FY 2012 President's Budget Request	**0.0**	**-**	**132.9**	**136.6**	**142.6**	**149.5**	**156.6**
ST Civil Service Labor and Expenses	0.0	-	132.9	136.6	142.6	149.5	156.6

Program Overview

This program contains labor funding, both salary and benefits, for civil service employees at NASA Centers who are assigned to work on projects in the Space Technology programs. These funds support the critical skills and capabilities required to provide technology development, as outlined in the other programs, within this mission area.